

# 81289-284779-modified.ST25.txt SEQUENCE LISTING

RA	<110>	Hovanec, Timothy A	
	<120>	Ammonia-Oxidizing Bacteria	
	<130>	81289-284779	
	<140> <141>	10/659,983 2003-09-10	
	<150> <151>	US 09/573,684 2000-05-19	
	<150> <151>	US 60/386,217 2002-09-19	
	<150> <151>	US 60/386,218 2002-09-19	
	<150> <151>	US 60/386,219 2002-09-19	
	<160>	23	
	<170>	PatentIn version 3.2	
	<210> <211> <212> <213>	1 1457 DNA Unknown	
	<220> <223>	AOB Type A R7clone140 16S rDNA	
	<400> attgaad	1 cgct ggcggcatgc tttacacatg caagtcgaac ggcagcacgg atgcttgcat	60
	ctggtgg	gcga gtggcggacg ggtgagtaat gcàtcggaac gtatccagaa gaggggggta	120
	acgcato	cgaa agatgtgcta ataccgcata tactctaagg aggaaagcag gggatcgaaa	180
	gaccttg	gcgc ttttggagcg gccgatgtct gattagctag ttggtggggt aaaggcctac	240
	caaggcg	gacg atcagtagtt ggtctgagag gacgaccagc cacactggga ctgagacacg	300
	gcccaga	actc ctacgggagg cagcagtggg gaattttgga caatgggcgc aagcctgatc	360
	cagcaat	tgcc gcgtgagtga agaaggcctt cgggttgtaa agctctttca gtcgagaaga	420
	aaaggtt	tacg gtaaataatc gtgactcatg acggtatcga cagaagaagc accggctaac	480
	tacgtgo	ccag cagccgcggt aatacgtagg gtgcaagcgt taatcggaat tactgggcgt	540
	aaagggt	tgcg caggcggctt tgtaagtcag atgtgaaatc cccgggctta acctgggaat	600
	tgcgttt	tgaa actacaaggc tagagtgtgg cagagggagg tggaattcca tgtgtagcag	660
	tgaaatg	gcgt agagatatgg aagaacatcg atggcgaagg cagcctcctg ggttaacact	720
	gacgcto	catg cacgaaagcg tggggagcaa acaggattag ataccctggt agtccacgcc	780
	ctaaacg	gatg tcaactagtt gttgggcctt attaggcttg gtaacgaagc taacgcgtga Page 1	840

agttgaccgc	ctggggagta	cggtcgcaag	attaaaactc	aaaggaattg	acggggaccc	900
gcacaagcgg	tggattatgt	ggattaattc	gatgcaacgc	gaaaaacctt	acctaccctt	960
gacatgtagc	gaattttcta	gagatagatt	agtgcttcgg	gaacgctaac	acaggtgctg	1020
catggctgtc	gtcagctcgt	gtcgtgagat	gttgggttaa	gtcccgcaac	gagcgcaacc	1080
cttgtcatta	attgccatca	tttggttggg	cactttaatg	agactgccgg	tgacaaaccg	1140
gaggaaggtg	gggatgacgt	caagtcctca	tggcccttat	gggtagggct	tcacacgtaa	1200
tacaatggcg	cgtacagagg	gttgccaacc	cgcgaggggg	agctaatctc	agaaagcgcg	1260
tcgtagtccg	gatcggagtc	tgcaactcga	ctccgtgaag	tcggaatcgc	tagtaatcgc	1320
ggatcagcat	gtcgcggtga	atacgttccc	gggtcttgta	cacaccgccc	gtcacaccat	1380
gggagtgggt	ttcaccagaa	gcaggtagtc	taaccgtaag	gagggcgctt	gccacggtga	1440
gattcatgac	tggggtg					1457

<210> 2 <211> 1457

<212> DNA <213> Unknown

<220>

<223> AOB Type A1 R7clone187 16S rDNA

<400> 2 attgaacgct ggcggcatgc tttacacatg caagtcgaac ggcagcacgg atgcttgcat 60 ctggtggcga gtggcggacg ggtgagtaat gcatcggaac gtatccagaa gaggggggta 120 180 acgcatcgaa agatgtgcta ataccgcata tactctaagg aggaaagcag gggatcgaaa 240 gaccttgcgc ttttggagcg gccgatgtct gattagctag ttggtggggt aaaggcctac 300 caaggcgacg atcagtagtt ggtctgagag gacgaccagc cacactggga ctgagacacg gcccagactc ctacgggagg cagcagtggg gaattttgga caatgggcgc aagcctgatc 360 cagcaatgcc gcgtgagtga agaaggcctt cgggttgtaa agctctttca gtcgagaaga 420 aaaggttacg gtaaataatc gtgacccatg acggtatcga cagaagaagc accggctaac 480 tacgtgccag cagccgcggt aatacgtagg gtgcaagcgt taatcggaat tactgggcgt 540 600 aaagggtgcg caggcggcct tgtaagtcag atgtgaaatc cccgggctta acctgggaat 660 tgcgtttgaa actacaaagc tagagtgtgg cagagggagg tggaattcca tgtgtagcag 720 tgaaatgcgt agagatatgg aagaacatcg atggcgaagg cagcctcctg ggttaacact 780 gacgctcatg cacgaaagcg tggggagcaa acaggattag ataccctggt agtccacgcc ctaaacgatg tcaactagtt gttgggcctt attaggcttg gtaacgaagc taacgcgtga 840 900 agttgaccgc ctggggagta cggtcgcaag attaaaactc aaaggaattg acggggaccc

81289-284779-modified.ST25.txt gcacaagcgg tggattatgt ggattaattc gatgcaacgc gaaaaacctt acctaccctt	960
gacatgtagc gaattttcta gagatagatt agtgcttcgg gaacgctaac acaggtgctg	1020
catggctgtc gtcagctcgt gtcgtgagat gttgggttaa gtcccgcaac gagcgcaacc	1080
cttgtcatta attgccatca tttggttggg cactttaatg agactgccgg tgacaaaccg	1140
gaggaaggtg gggatgacgt caagtcctca tggcccttat gggtagggct tcacacgtaa	1200
tacaatggcg cgtacagagg gttgccaacc cgcgaggggg agctaatctc agaaagcgcg	1260
tcgtagtccg gatcggagtc tgcaactcga ctccgtgaag tcggaatcgc tagtaatcgc	1320
ggatcagcat gtcgcggtga atacgttccc gggtcttgta cacaccgccc gtcacaccat	1380
gggagtgggt ttcaccagaa gcaggtagtc taaccgtaag gagggcgctt gccacggtga	1440
gattcatgac tggggtg	1457
<210> 3 <211> 1458 <212> DNA <213> Unknown <220> <223> AOB Type B R3clone5 16S rDNA	
<400> 3 attgaacgct ggcggcatgc tttacacatg caagtcgaac ggcagcacgg gggcaaccct	60
ggtggcgagt ggcgaacggg tgagtaatac atcggaacgt atcttcgagg gggggataac	120
gcaccgaaag gtgtgctaat accgcataat ctccacggag aaaagcaggg gatcgcaaga	180
ccttgcgctc ttggagcggc cgatgtctga ttagctagtt ggtgaggtaa tggcttacca	240
aggcgacgat cagtagctgg tctgagagga cgaccagcca cactgggact gagacacggc	300
ccagactcct acgggaggca gcagtgggga attttggaca atgggggaaa ccctgatcca	360
gccatgccgc gtgagtgaag aaggccttcg ggttgtaaag ctctttcagc cggaacgaaa	420
cggtcacggc taatacccgt gactactgac ggtaccggaa gaagaagcac cggctaacta	480
cgtgccagca gccgcggtaa tacgtagggt gcaagcgtta atcggaatta ctgggcgtaa	540
agcgtgcgca ggcggttttg taagtcagat gtgaaagccc cgggcttaac ctgggaactg	600
cgtttgaaac tacaaggcta gagtgtggca gaggggggtg gaattccacg tgtagcagtg	660
aaatgcgtag agatgtggag gaacaccgat ggcgaaggca gccccctggg ttaacaccga	720
cgctcaggca cgaaagcgtg gggagcaaac aggattagat accctggtag tccacgccct	780
aaacgatgtc aactagttgt cgggtcttaa cggacttggt aacgcagcta acgcgtgaag	840
ttggccgcct ggggagtacg gtcgcaagat taaaactcaa aggaattgac ggggacccgc	900
acaagcggtg gattatgtgg attaattcga tgcaacgcga aaaaccttac ctacccttga	960
catgtaccga agcccgccga gaggtgggtg tgcccgaaag ggagcggtaa cacaggtgct Page 3	1020

gcatggctgt	cgtcagctcg	tgtcgtgaga	tgttgggtta	agtcccgcaa	cgagcgcaac	1080
ccttgtcatt	aattgccatc	attcagttgg	gcactttaat	gaaactgccg	gtgacaaacc	1140
ggaggaaggt	ggggatgacg	tcaagtcctc	atggccctta	tgggtagggc	ttcacacgta	1200
atacaatggc	gcgtacagag	ggttgccaac	ccgcgagggg	gagctaatct	cagaaagcgc	1260
gtcgtagtcc	ggatcggagt	ctgcaactcg	actccgtgaa	gtcggaatcg	ctagtaatcg	1320
cggatcagca	tgtcgcggtg	aatacgttcc	cgggtcttgt	acacaccgcc	cgtcacacca	1380
tgggagtggg	tttcaccaga	agcaggtagt	ctaaccgcaa	ggagggcgct	tgccacggtg	1440
agattcatga	ctggggtg					1458

<210> 4 <211> 1460 <212> DNA

<213> Unknown

<220>

<223> AOB Type C R5clone47 16D rDNA

<400> 4 60 attgaacgct ggcggcatgc tttacacatg caagtcgaac ggcagcgggg gcttcggcct 120 gccggcgagt ggcgaacggg tgagtaatac atcggaacgt gtccttaagt ggggaataac 180 gcatcgaaag atgtgctaat accgcatatc tctgaggaga aaagcagggg atcgcaagac cttgcgctaa aggagcggcc gatgtctgat tagctagttg gtggggtaaa ggcttaccaa 240 300 ggcaacgatc agtagttggt ctgagaggac gaccaaccac actgggactg agacacggcc 360 cagactccta cgggaggcag cagtggggaa ttttggacaa tgggcgaaag cctgatccag 420 ccatgccgcg tgagtgaaga aggccttcgg gttgtagagc tcttttagtc agaaagaaag 480 aatcatgatg aataattatg atttatgacg gtactgacag aaaaagcacc ggctaactac gtgccagcag ccgcggtaat acgtagggtg cgagcgttaa tcggaattac tgggcgtaaa 540 600 gggtgcgcag gcggttttgt aagtcagatg tgaaagcccc gggcttaacc tgggaattgc 660 gtttgaaact acaaggctag agtgcagcag aggggagtgg aattccatgt gtagcagtga aatgcgtaga gatgtggaag aacaccgatg gcgaaggcag ctccctgggt tgacactgac 720 780 gctcatgcac gaaagcgtgg ggagcaaaca ggattagata ccctggtagt ccacgcccta 840 aacgatgtca actggttgtc ggatctaatt aaggatttgg taacgtagct aacgcgtgaa 900 gttgaccgcc tggggagtac ggtcgcaaga ttaaaactca aaggaattga cggggacccg 960 cacaagcggt ggattatgtg gattaattcg atgcaacgcg aaaaacctta cctacccttg 1020 acatgcttgg aatctagtgg agacataaga gtgcccgaaa gggagccaag acacaggtgc 1080 tgcatggctg tcgtcagctc gtgtcgtgag atgttgggtt aagtcccgca acgagcgcaa

			01,000	_ / X // / / U _ M // / '	17100 6176 1	TVT	
cccttg	tcac	taattgctat			gtgagactgc		1140
ccggag	gaag	gtggggatga	cgtcaagtcc	tcatggccct	tatgggtagg	gcttcacacg	1200
taataca	aatg	gcgtgtacag	agggttgcca	acccgcgagg	gggagccaat	ctcagaaagc	1260
acgtcgt	tagt	ccggatcgga	gtctgcaact	cgactccgtg	aagtcggaat	cgctagtaat	1320
cgcgga	tcag	catgccgcgg	tgaatacgtt	cccgggtctt	gtacacaccg	cccgtcacac	1380
catggga	agtg	gttttcacca	gaagcaggta	gtttaaccgt	aaggaggacg	cttgccacgg	1440
tggggg	tcat	gactggggtg					1460
<210> <211> <212> <213>	5 18 DNA Arti	ficial					
<220> <223>	olig	gonucleotide	Probe				
<400> ccccc1	5 t <b>ct</b> t	ctggatac					18
<210> <211> <212> <213>	6 18 DNA Arti	ficial					
<220> <223>	PCR	Primer					
<400>	6	66393393					18
cyyaacı	jiai	ccagaaga					10
<210> <211> <212> <213>	7 18 DNA Arti	ficial					
<220> <223>	PCR	Primer					
	7 agaa	aattcgct					18
<210> <211> <212> <213>	8 19 DNA Arti	ficial					
<220> <223>	Olig	ponucleotide	e Probe				
<400> tcccca	8 actc	gaagatacg					19

<210><211><212><213>	9 17 DNA Artificial	
<220> <223>	PCR Primer	
<400> atcgga	9 acgt atcttcg	17
<210> <211> <212> <213>	10 16 DNA Artificial	
<220> <223>	PCR Primer	
<400> ccacct	10 ctcr gcgggc	16
<210> <211> <212> <213>	11 19 DNA Artificial	
<220> <223>	PCR Primer	
	11 agaa agaatcatg	19
<210> <211> <212> <213>	12 19 DNA Artificial	
<220> <223>	PCR Primer	
<400> gtctcc	12 ayta gattccaag	19
<210> <211> <212> <213>	13 17 DNA Artificial	
<220> <223>	PCR Primer	
<400> gtttga	13 tcct ggctcag	17
<210><211><211>	14 19	

#### 81289-284779-modified ST25 tyt

<213>	Arti	ficial	81289-	-284//9-mod <sup>-</sup>	1T1ea.5125.1	txτ		
<220> <223>	PCR	Primer						
	14 cttg	ttacgactt			·		19	
	17 DNA	ficial						
<220> <223>	PCR	Primer						
	15 ggag	gcagcag					17	
<211> <212>	18 Dna	ficial						
<220> <223>	PCR	Primer						
	16 cgc	ggckgctg					18	
<212>	20 Dna	ficial						
<220> <223>	PCR	Primer						
<400> cactcta		ttgtagtttc					20	
	18 1467 DNA Unkn							
<220> <223>	N. A	estuarii-li	ke AOB P4cl	one42 16S r	'DNA			
	18 itgg	ctcagattga	acgctggcgg	catgctttac	acatgcaagt	cgaacggcag	60	
cacgggt	gct	tgcacctggt	ggcgagtggc	ggacgggtga	gtaatgcatc	ggaacgtgtc	120	
cagaagt	ggg	ggataacgca	tcgaaagatg	tgctaatacc	gcatattctc	tacggaggaa	180	
agcaggg	gat	cgaaagacct	tgtgcttttg	gagcggccga	tgcctgatta	gctagttggt	240	
ggggtaa	agg	cctaccaagg	caacgatcag	tagttggtct Page		ccagccacac	300	

tgggactgag acacggccca	gactcctacg	ggaggcagca	gtggggaatt	ttggacaatg	360
ggcgaaagcc tgatccagca	atgccgcgtg	agtgaagaag	gcttcgggtt	gtaaagctct	420
ttcagtcgag aagaaaaggt	tgtgactaat	aatcacaact	tatgatggta	ccgacagaag	480
aagcaccggc taactacgtg	ccagcagccg	cggtaatacg	tagggtgcaa	gcgttaatcg	540
gaattactgg gcgtaaaggg	tgcgcaggcg	gctttgtaag	tcagatgtga	aatccccggg	600
cttaacctgg gaattgcgtt	tgaaactaca	aagctagagt	gtagcagagg	ggggtggaat	660
tccatgtgta gcagtgaaat	gcgtagagat	atggaagaac	atcgatggcg	aaggcagccc	720
cctgggttaa cactgacgct	catgcacgaa	agcgtgggga	gcaaacagga	ttagataccc	780
tggtagtcca cgccctaaac	gatgtcaact	agttgttggg	ccttactagg	cttggtaacg	840
tagctaacgc gtgaagttga	ccgcctgggg	agtacggtcg	caggattaaa	actcaaagga	900
attgacgggg acccgcacaa	gcggtggatt	atgtggatta	attcgatgca	acgcgaaaaa	960
ccttacctac ccttgacatg	tagcgaatat	tttagagata	aaatagtgcc	ttcgggaacg	1020
ctaacacagg tgctgcatgg	ctgtcgtcag	ctcgtgtcgt	gagatgttgg	gttaagtccc	1080
gcaacgagcg caacccttgt	cattaattgc	catcatttag	ttgggcactt	taatgagact	1140
gccggtgaca aaccggagga	aggtggggat	gacgtcaagt	cctcatggcc	cttatgggta	1200
gggcttcaca cgtaatacaa	tggcgcgtac	agagggttgc	caacccgcga	gggggagcta	1260
atctcagaaa gcgcgtcgta	gtccggatcg	gagtctgcaa	ctcgactccg	tgaagtcgga	1320
atcgctagta atcgcggatc	agcatgtcgc	ggtgaatacg	ttcccgggtc	ttgtacacac	1380
cgcccgtcac accatgggag	tgggtttcac	cagaagcaga	tagtctaacc	gtaagagggc	1440
gtttgccacg gcgagattca	tgactgg				1467

19 1494 DNA

Unknown

<220>

<223> N. Aestuarii-like AOB P4clone31 16S rDNA

<400> 60 agtttgatca tggctcagat tgaacgctgg cggcatgctt tacacatgca agtcgaacgg 120 cagcacgggt gcttgcacct ggtggcgagt ggcggacggg tgagtaatgc atcggaacgt 180 gtccggaagt gggggataac gcatcgaaag atgtgctaat accgcatatt ctctacggag 240 gaaagcaggg gatcgaaaga ccttgtgctt ttggagcggc cgatgcctga ttagctagtt 300 ggtggggtaa aggcctacca aggcaacgat cagtagttgg tctgagagga cgaccagcca 360 cactgggact gagacacggc ccagactcct acgggaggca gcagtgggga attttggaca

81289-284779-modified.ST25.txt acgggcgaaa gcctgatcca gcaatgccgc gtgagtgaag aaggccttcg ggttgtaaag	420
ctctttcagt cgagaagaaa aggttgtgac taataatcac aacttatgac ggtaccgaca	480
gaagaagcac cggctaacta cgtgccagca gccgcggtaa tacgtagggt gcaagcgtta	540
atcggaatta ctgggcgtaa agggtgcgca ggcggctttg taagtcagat gtgaaatccc	600
cgggcttaac ctgggaattg cgtttgaaac tacaaagcta gagtgtagca gaggggggtg	660
gaattccatg tgtagcagtg aaatgcgtag agatatggaa gaacatcgat ggcgaaggca	720
gccccctggg ttaacactga cgctcatgca cgaaagcgtg gggagcaaac aggattagat	780
accctggtag tccacgccct aaacgatgtc aactagttgt tgggccttac taggcttggt	840
aacgtagcta acgcgtgaag ttgaccgcct ggggagtacg gtcgcaagat taaaactcaa	900
aggaattgac ggggacccgc acaagcggtg gattatgtgg attaattcga tgcaacgcga	960
aaaaccttac ctacccttga catgtagcga atattttaga gataaaatag tgccttcggg	1020
aacgctaaca caggtgctgc atggctgtcg tcagctcgtg tcgtgagatg ttgggttaag	1080
tcccgcaacg agcgcaaccc ttgtcattaa ttgccatcat ttagttgggc actttaatga	1140
gactgccggt gacaaaccgg aggaaggtgg ggatgacgtc aagtcctcat ggcccttatg	1200
ggtagggctt cacacgtaat acaatggcgc gtacagaggg ttgccaaccc gcgaggggga	1260
gctaatctca gaaagcgcgt cgtagtccgg atcggagtta gcaactcgac tccgtgaagt	1320
cggaatcgct agtaatcgcg gatcagcatg tcgcggtgaa tacgttcccg ggccttgtac	1380
acaccgcccg tcacaccatg gaagttggct gcaccagaag taggttgtct aaccctcggg	1440
aggacgctta ccacggtgtg gtcaatgact tggggtgaag tcgtaacaag gtaa	1494
<210> 20 <211> 1491 <212> DNA <213> Unknown <220> <220> <223> N. Aestuarii-like AOB BF16clone57 16S rDNA	
<400> 20 gtttgatcat ggctcagatt gaacgctggc ggcatgcttt acacatgcaa gtcgaacggc	·60
agcacgggtg cttgcacctg gtggcgagtg gcggacgggt gagtaatgca tcggaacgtg	120
tccagaagtg ggggataacg catcgaaaga tgtgctaata ccgcatattc tctacggagg	180
aaagcagggg atcgaaagac cttgtgcttt tggagcggcc gatgcctgat tagctagttg	240
gtggggtaaa ggcctaccaa ggcaacgatc agtagttggt ctgagaggac gaccagccac	300
actgggactg agacacggcc cagactccta cgggaggcag cagtggggaa ttttggacaa	360
tgggcgaaag cctgatccag caatgccgcg tgagtgaaga aggccttcgg gttgtaaagc	420
tctttcagtc gagaagaaaa ggttgtgact aataatcaca acttatgacg gtaccgacag Page 9	480

540

aagaagcacc ggctaactac gtgccagcag ccgcggtaat acgtagggtg caagcgttaa

aagaag	cace ggetaactae	gegeeageag	cegeggeauc	acgeagggeg	caagegeeaa	3.0
tcggaa	ttac tgggcgtaaa	gggtgcgcag	gcggctttgt	aagtcagatg	tgaaatcccc	600
gggctt	aacc tgggaattgc	gtttgaaact	acaaagctag	agtgtagcag	aggggggtgg	660
aattcc	atgt gtagcagtga	aatgcgtaga	gatatggaag	aacatcgatg	gcgaaggcag	720
ccccct	gggt taacactgac	gctcatgcac	gaaagcgtgg	ggagcaaaca	ggattagata	780
ccctgg	tagt ccacgcccta	aacgatgtca	actagttgtt	gggccttact	aggcttggta	840
acgtag	ctaa cgcgtgaagt	tgaccgcctg	gggagtacgg	tcgcaagatt	aaaactcaaa	900
ggaatt	gacg gggacccgca	caagcggtgg	attatgtgga	ttaattcgat	gcaacgcgaa	960
aaacct	tacc tacccttgac	atgtagcgaa	tattttagag	ataaaatagt	gccttcggga	1020
acgcta	acac aggtgctgca	tggctgtcgt	cagctcgtgt	cgtgagatgt	tgggttaagt	1080
cccgca	acga gcgcaaccct	tgtcattaat	tgccatcatt	tagttgggca	ctttaatgag	1140
actgcc	ggtg acaaaccgga	ggaaggtggg	gatgacgtca	agtcctcatg	gcccttatgg	1200
gtaggg	cttc acacgtaata	caatggcgcg	tacagagggt	tgccaacccg	cgagggggag	1260
ctaatc	tcag aaagcgcgtc	gtagtccgga	tcggagtctg	caactcgact	ccgtgaagtc	1320
ggaatc	gcta gtaatcgcgg	atcagcatgt	cgcggtgaat	acgttcccgg	gtcttgtaca	1380
caccgc	ccgt cacaccatgg	gagtgggttt	caccagaagc	agatagtcta	accgtaagga	1440
gggcgt	ttgc cacggtgaga	ttcatgactg	gggtgaagtc	gtaacaattt	a	· 1491
<210> <211> <212> <213> <220> <223>	21 18 DNA Artificial	e Probe				
<400> tccccc	21 actt ctggacac					. 18
<210> <211> <212> <213>	22 21 DNA Artificial					
<220> <223>	PCR Primer					
<400> gtgact	22 aata atcacaactt	a				21
<210> <211> <212>	23 20 DNA		Page	10		

<213> Artificial

<220> <223> PCR Primer

<400> 23 ttatctctaa aatattcgct

20